Evaluation of the AIRS Surface Air Temperature and Relative Humidity

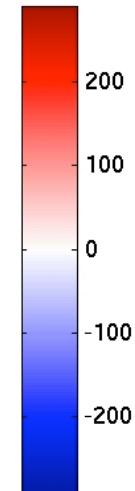Shenfu Dong[1], Sarah Gille[2], Janet Sprintall[2]
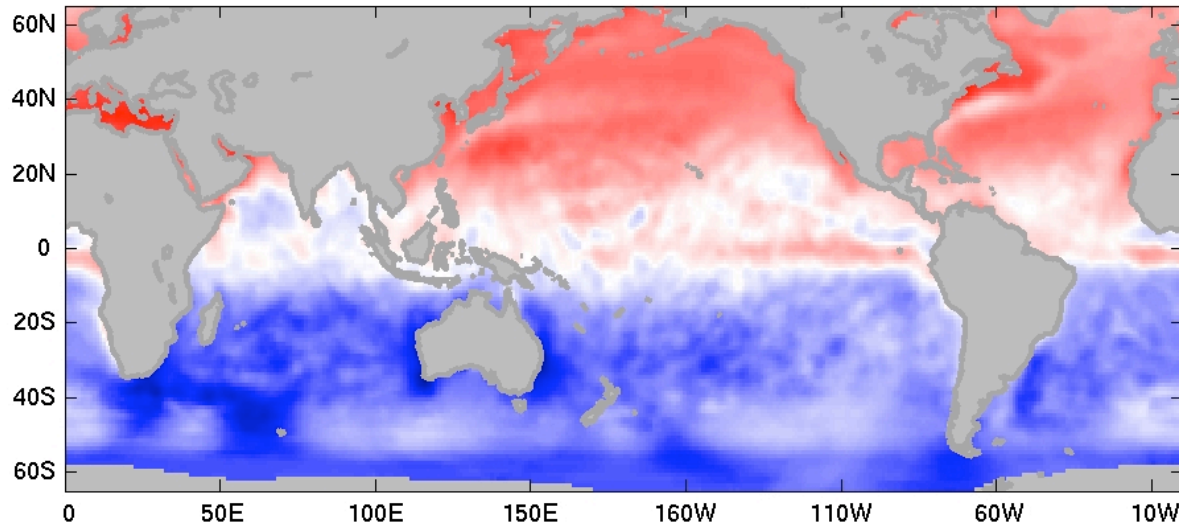
1. CIMAS/U. Miami – AOML/NOAA
2. Scripps Institution of Oceanography, UCSD

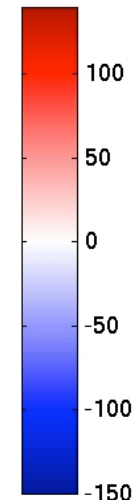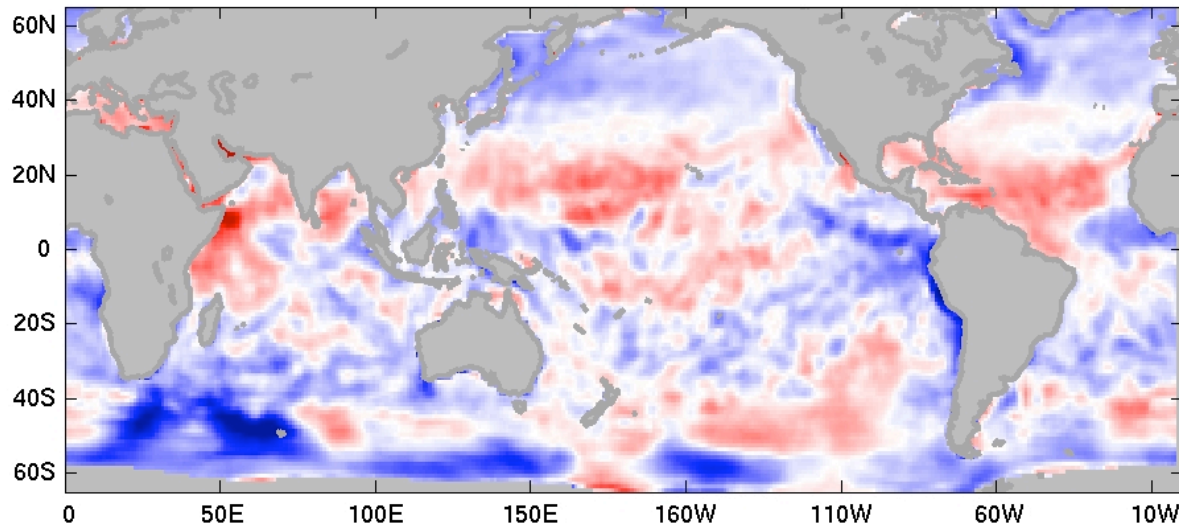Special thanks to Eric Fetzer

AIRS, March 29,2007

Uncertainty in Air-sea Heat Fluxes

Air-sea heat flux climatology from SOC - June

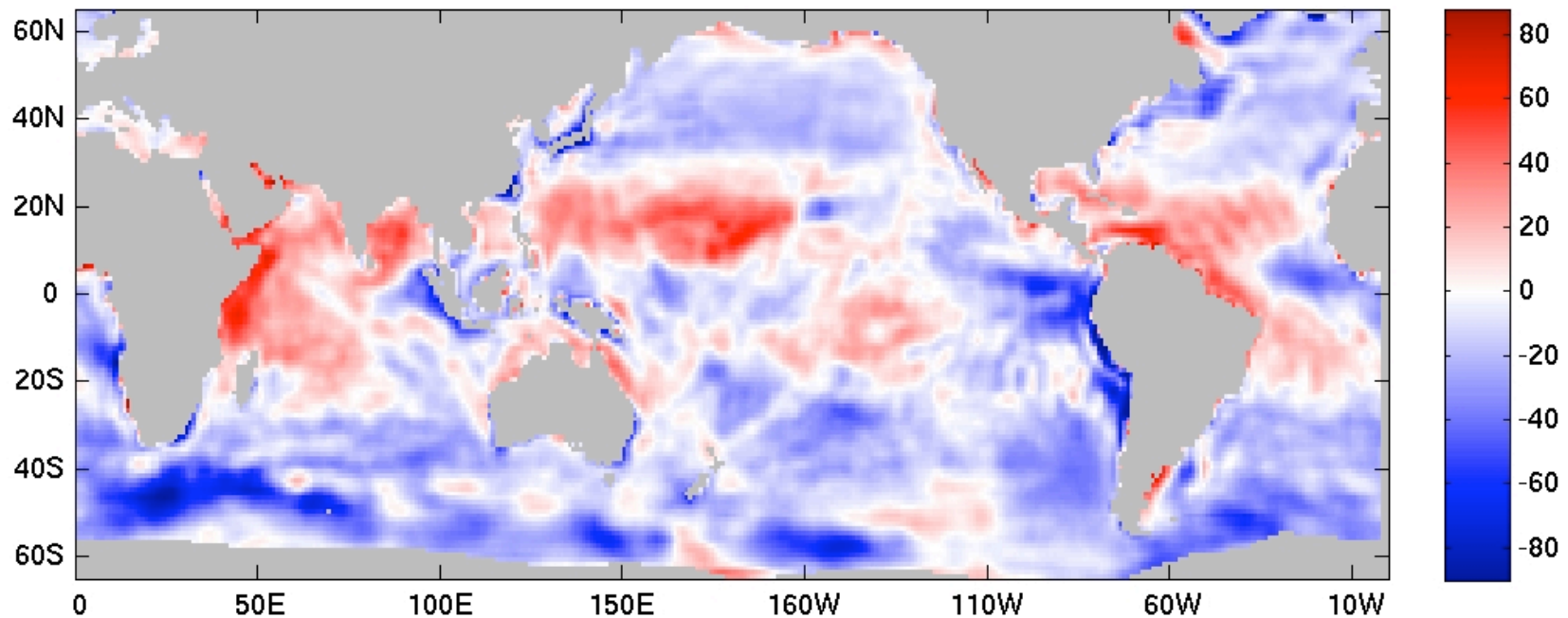**Long-term monthly mean air-sea heat fluxes (Q) in June from Southampton Oceanography Centre (SOC)**

Difference between SOC and NCEP/NCAR climatological air-sea heat fluxes - June

$\Delta Q = Q_{soc} - Q_{ncep/ncar}$
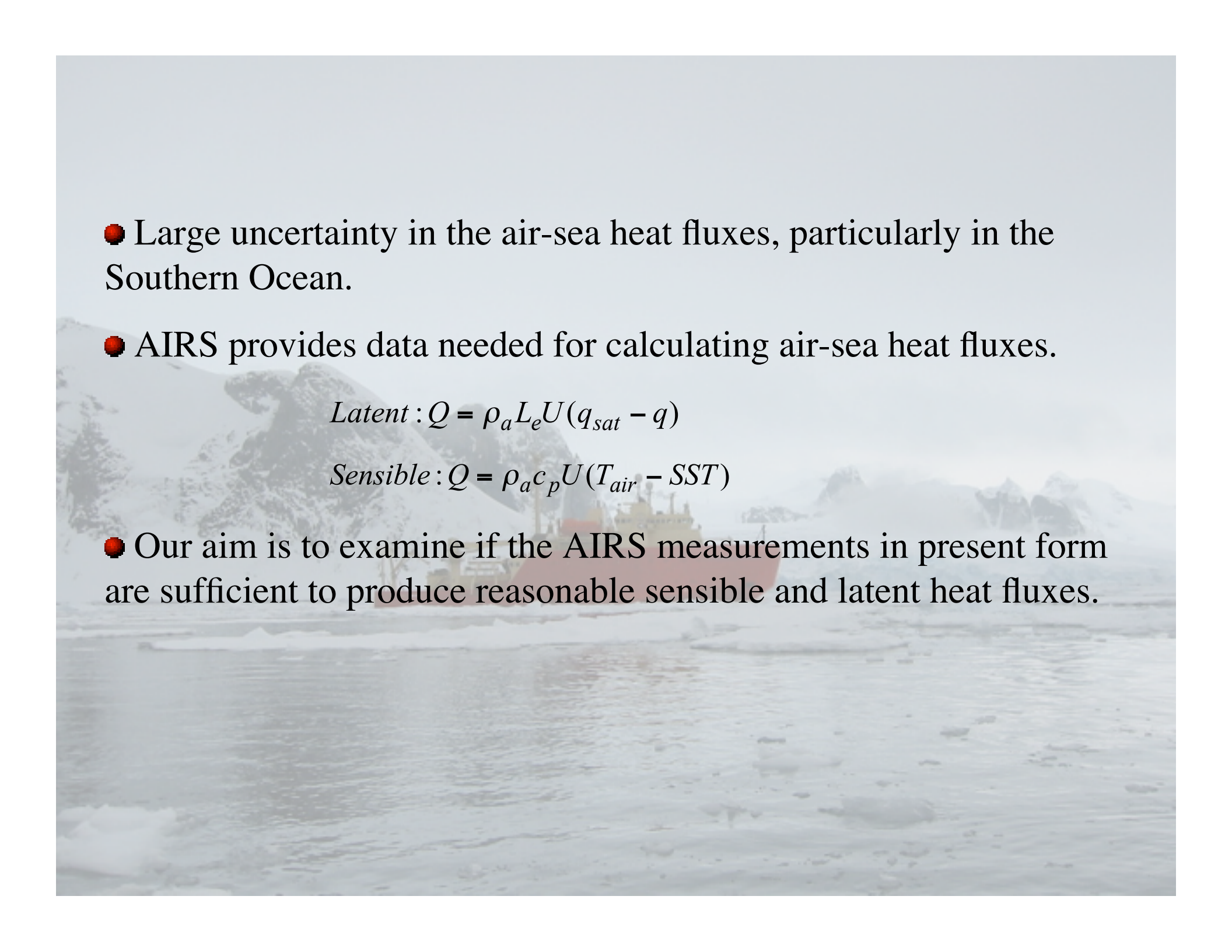
Large differences in the Southern Ocean

Uncertainty in Air-sea Heat Fluxes

$\Delta Q = Q_{soc} - Q_{ncep/ncar}$ **(12 months average)**

Large differences in the Southern Ocean

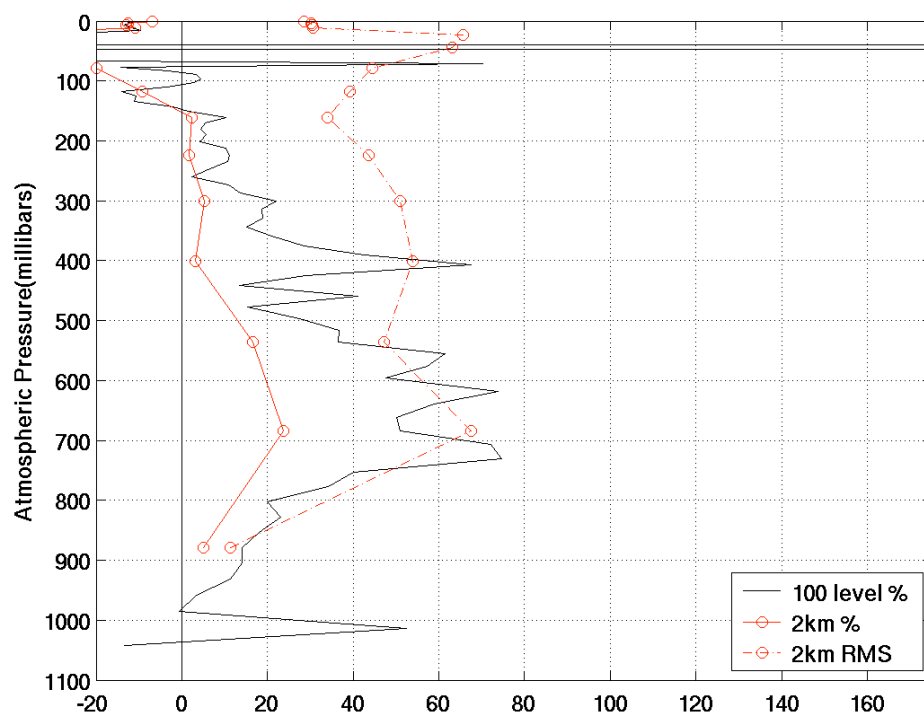- Large uncertainty in the air-sea heat fluxes, particularly in the Southern Ocean.

- AIRS provides data needed for calculating air-sea heat fluxes.

$$Latent : Q = \rho_a L_e U (q_{sat} - q)$$
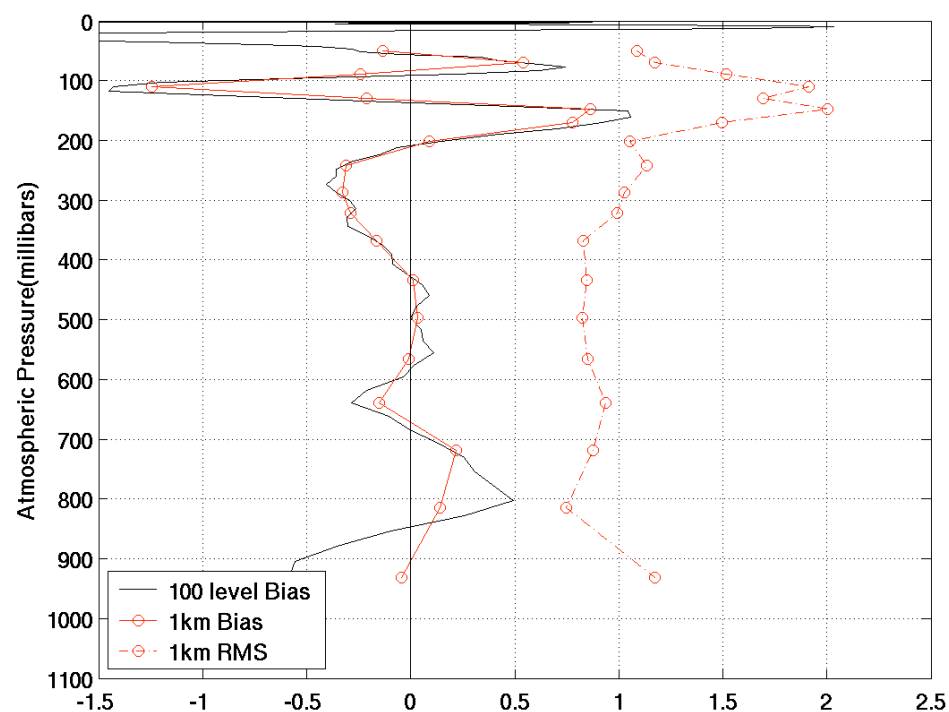
$$Sensible : Q = \rho_a c_p U (T_{air} - SST)$$

- Our aim is to examine if the AIRS measurements in present form are sufficient to produce reasonable sensible and latent heat fluxes.

# Comparison between AIRS and Radiosonde

Bias and rms water vapor difference between AIRS and radiodondes

Bias and rms temperature difference between AIRS and radiodondes

Wayne Feltz et al. (2007), based on 84 matched profiles from September 2002 – July 2004 from the Royal Caribbean cruise.

We assess the AIRS near surface relative humidity and temperature using in situ measurements from two regions: Southern Ocean and tropics.
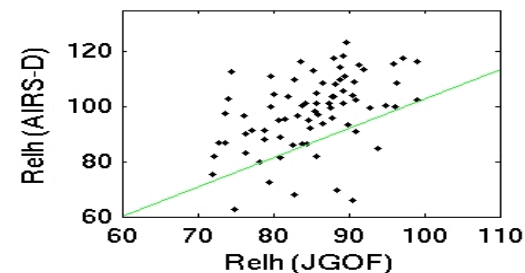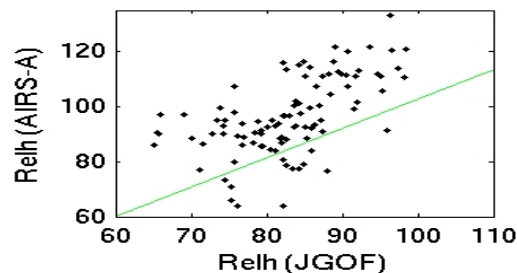
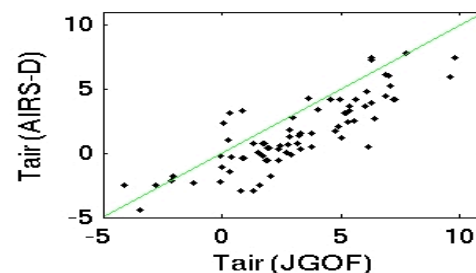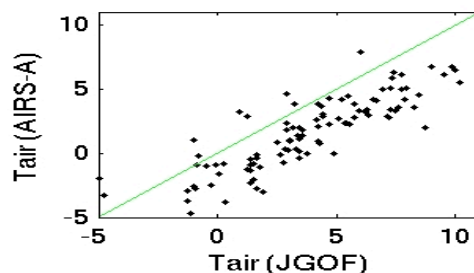# AIRS to Ship Measurements at Drake Passage

Ascending (daytime)   Descending (nighttime)
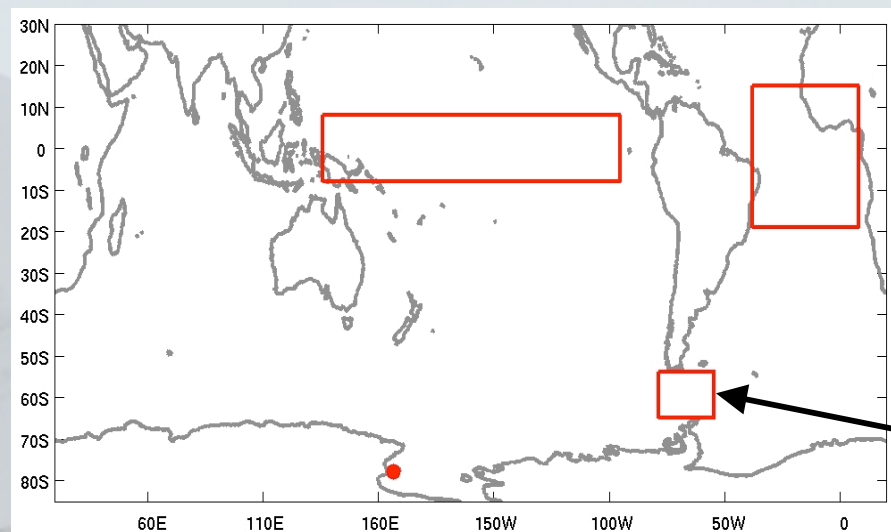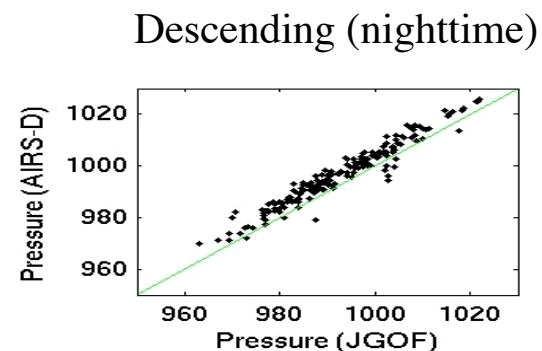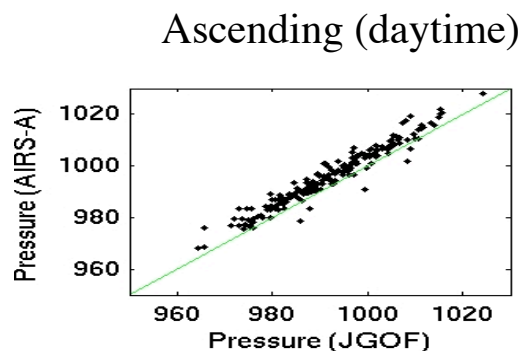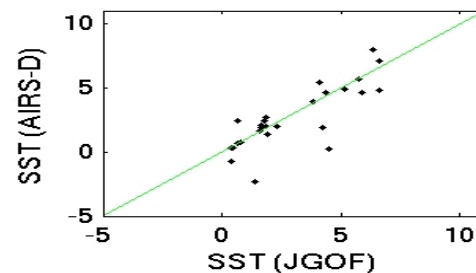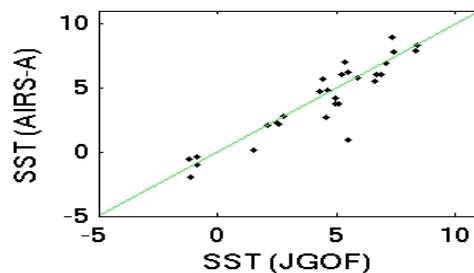
Sea level pressure

Surface relative humidity: Substantial scatter.

Surface air temperature: AIRS has cold bias.

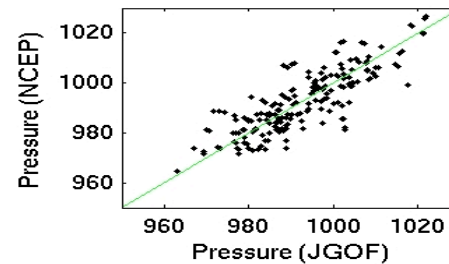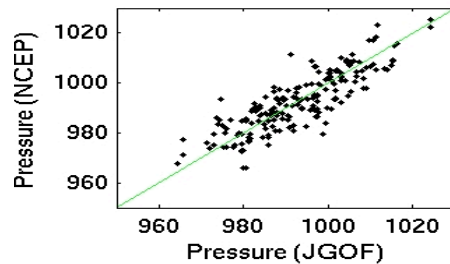**Sea surface temperature**

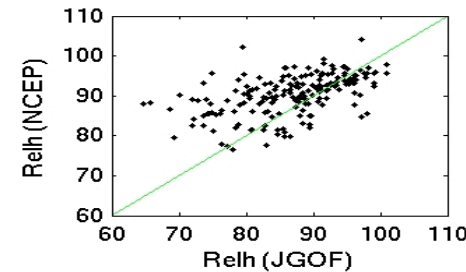# NCEP to Ship Measurements at Drake Passage
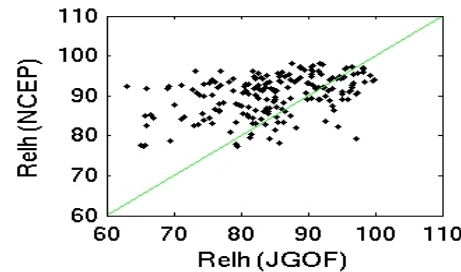

Ascending (daytime)   Descending (nighttime)

Sea level pressure

At present, NCEP provides better surface variable, but it has other problems for heat flux estimates.

Surface relative humidity

Air-sea temperature difference

Surface air temperature

Sea surface temperature
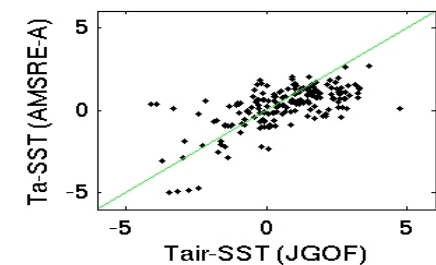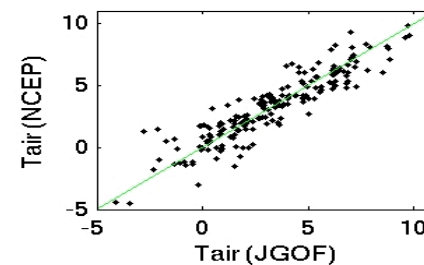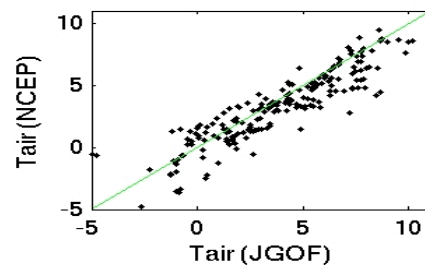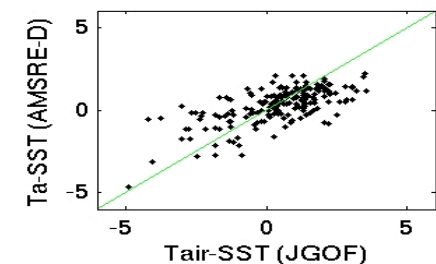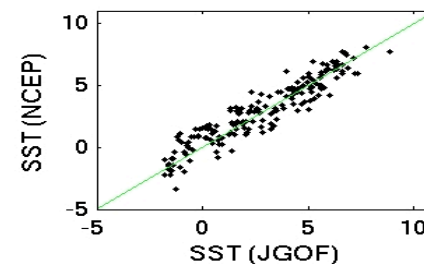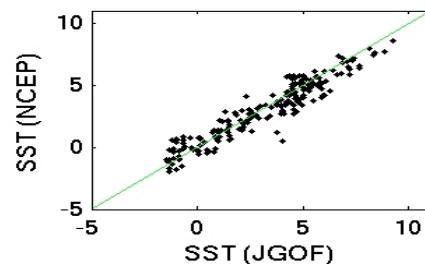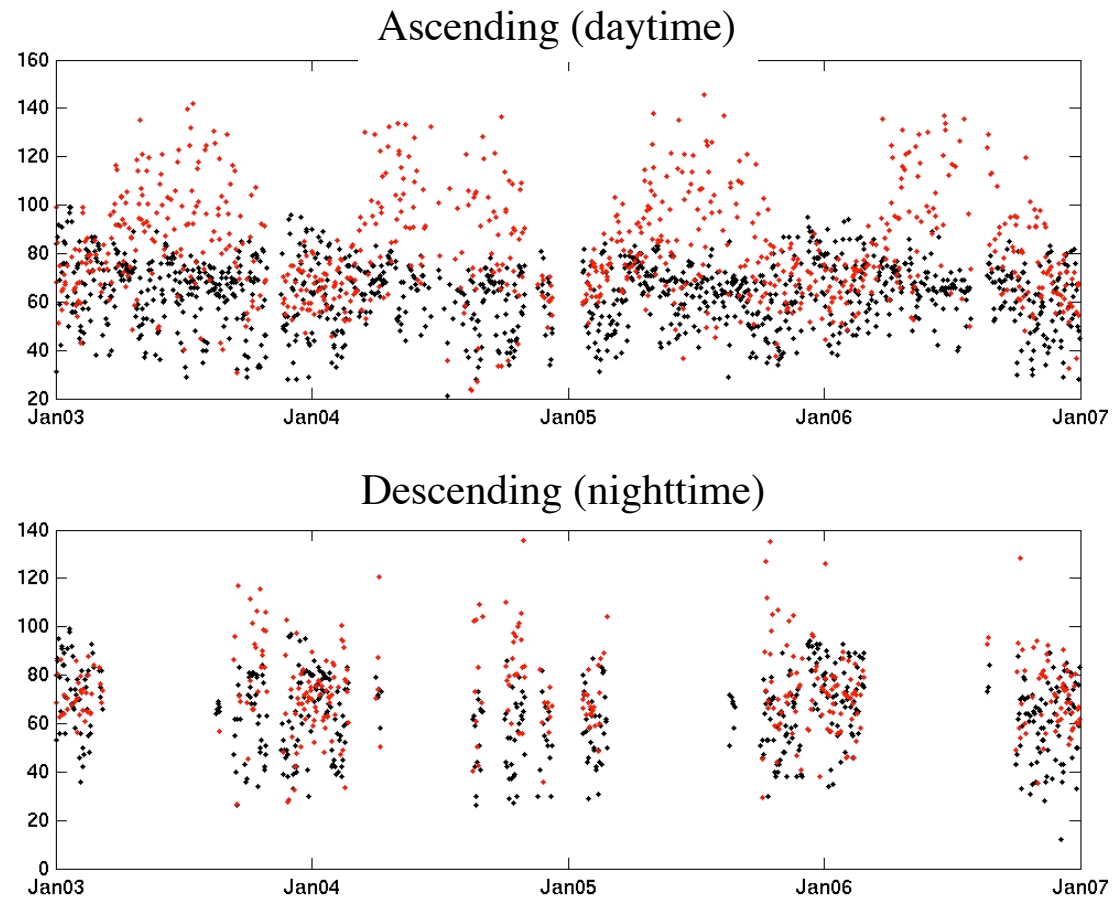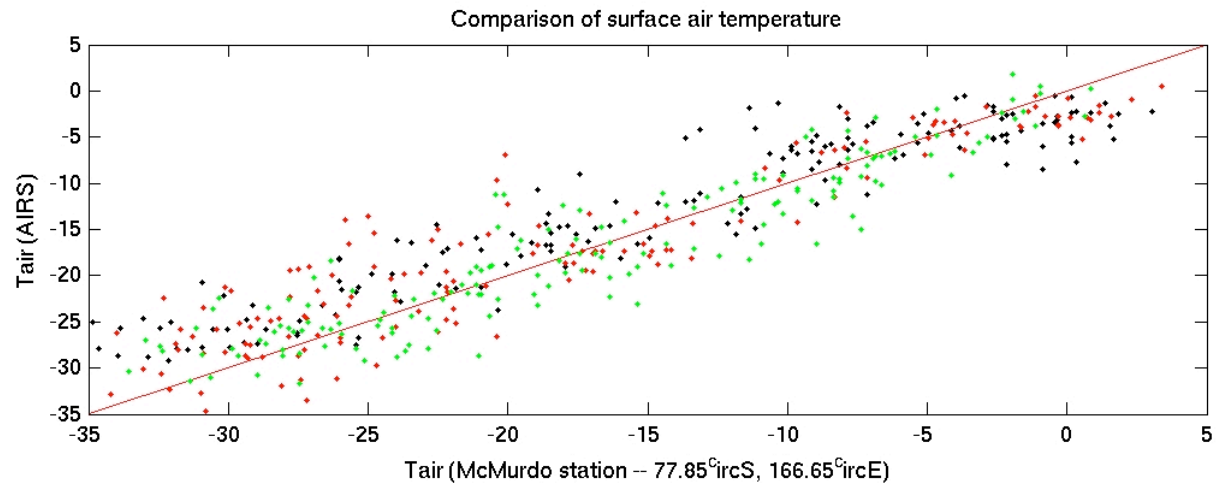
AIRS to Station McMurdo (77.85S, 166.65E)

Surface relative humidity: AIRS biases high during austral winter.

Ascending (daytime)

Descending (nighttime)

AIRS to Station McMurdo (77.85S, 166.65E)

Surface air temperature: AIRS follows the same trend, but scatters.

Comparison of surface air temperature
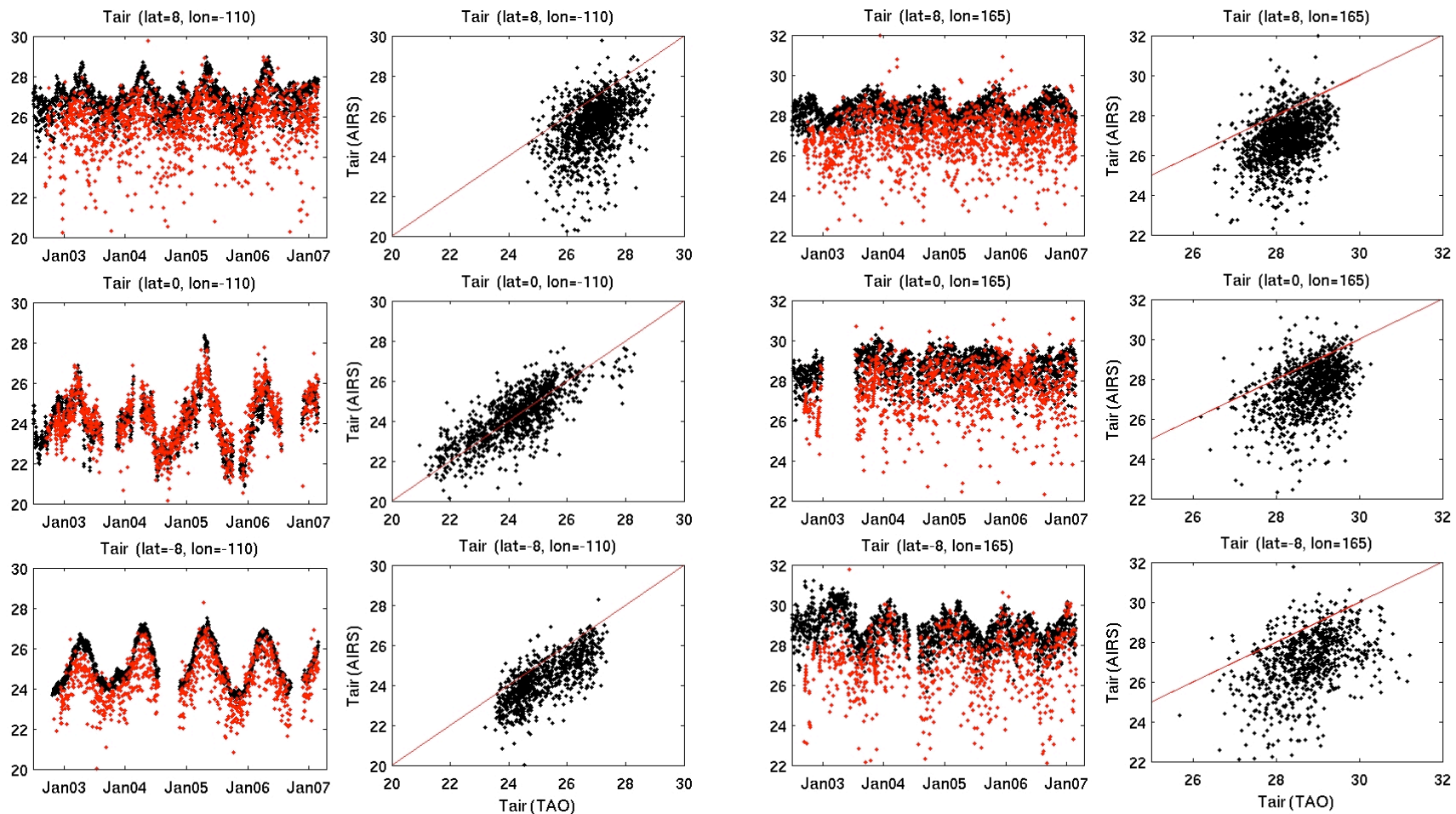
Ascending (daytime)

Descending (nighttime)

AIRS to TAO Buoy Data (surface relative humidity)
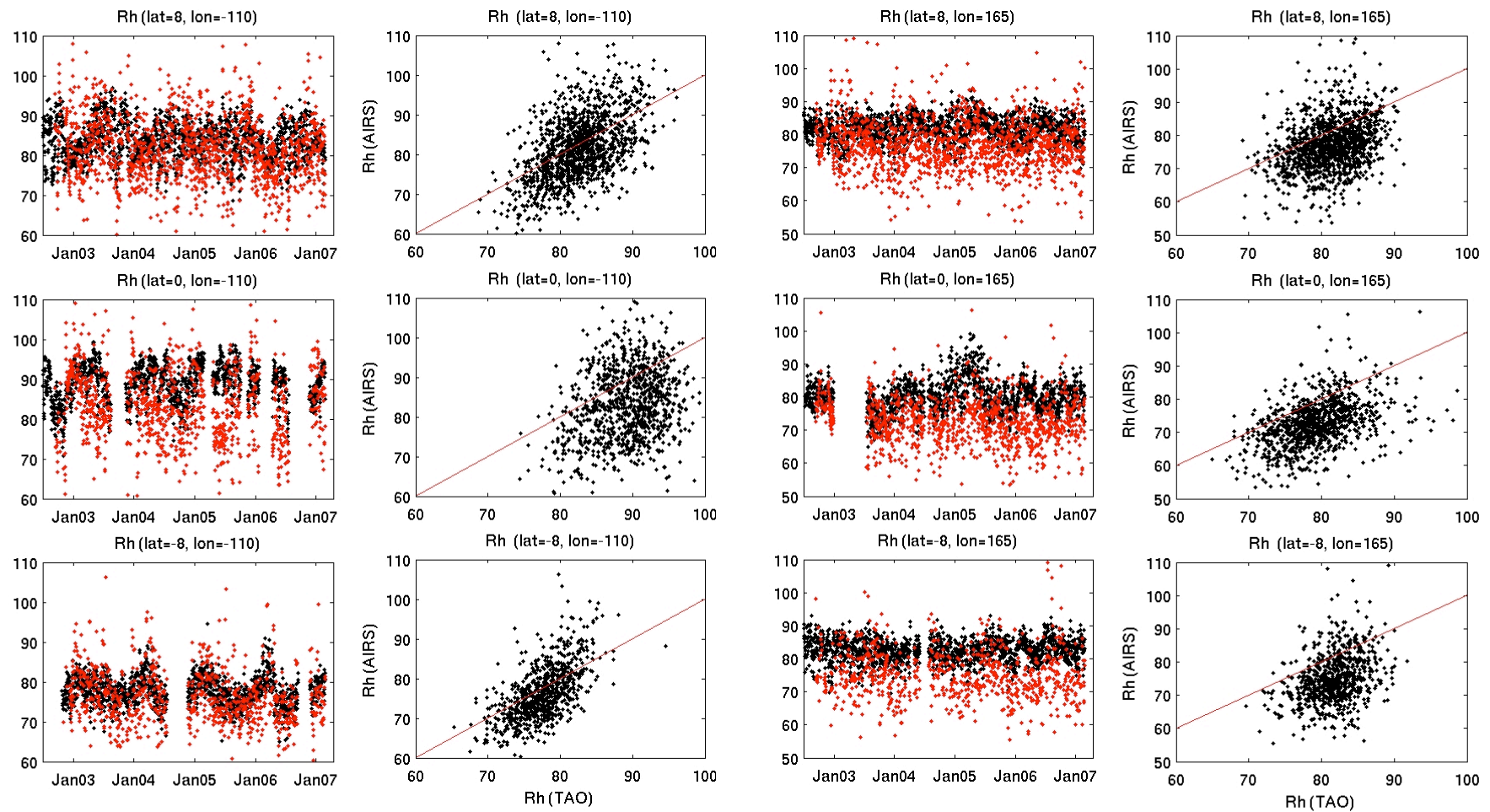
Red --- AIRS
Black ---TAO

AIRS to TAO Buoy Data (surface air temperature)
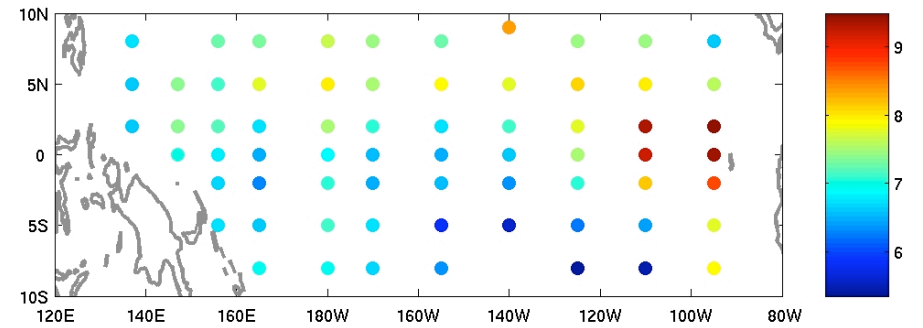

Red --- AIRS
Black ---TAO

AIRS to TAO Buoy Data

Mean Biases of the surface Relh
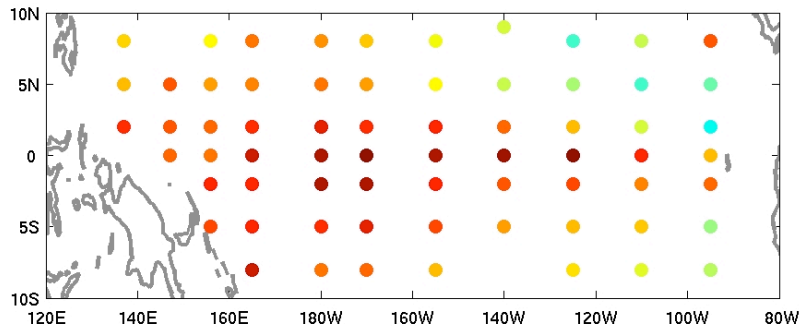
Standard deviation of the surface Relh differences

Mean Biases of the surface Tair

Standard deviation of the surface Tair differences

AIRS to PIRATA Buoy Data

Surface relative humidity

Surface air temperature

Red --- AIRS
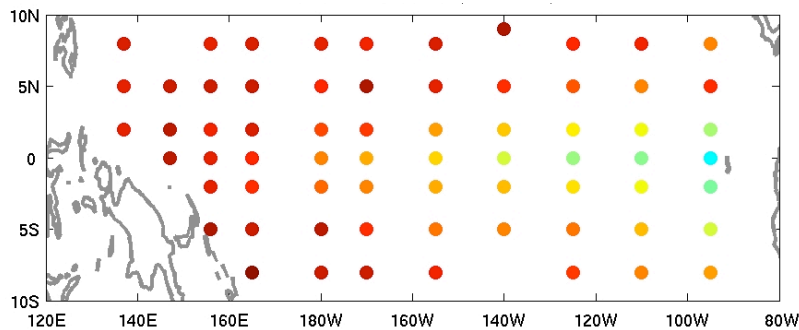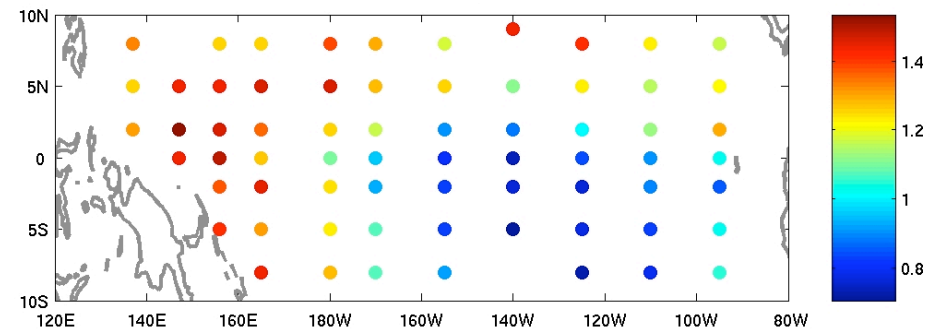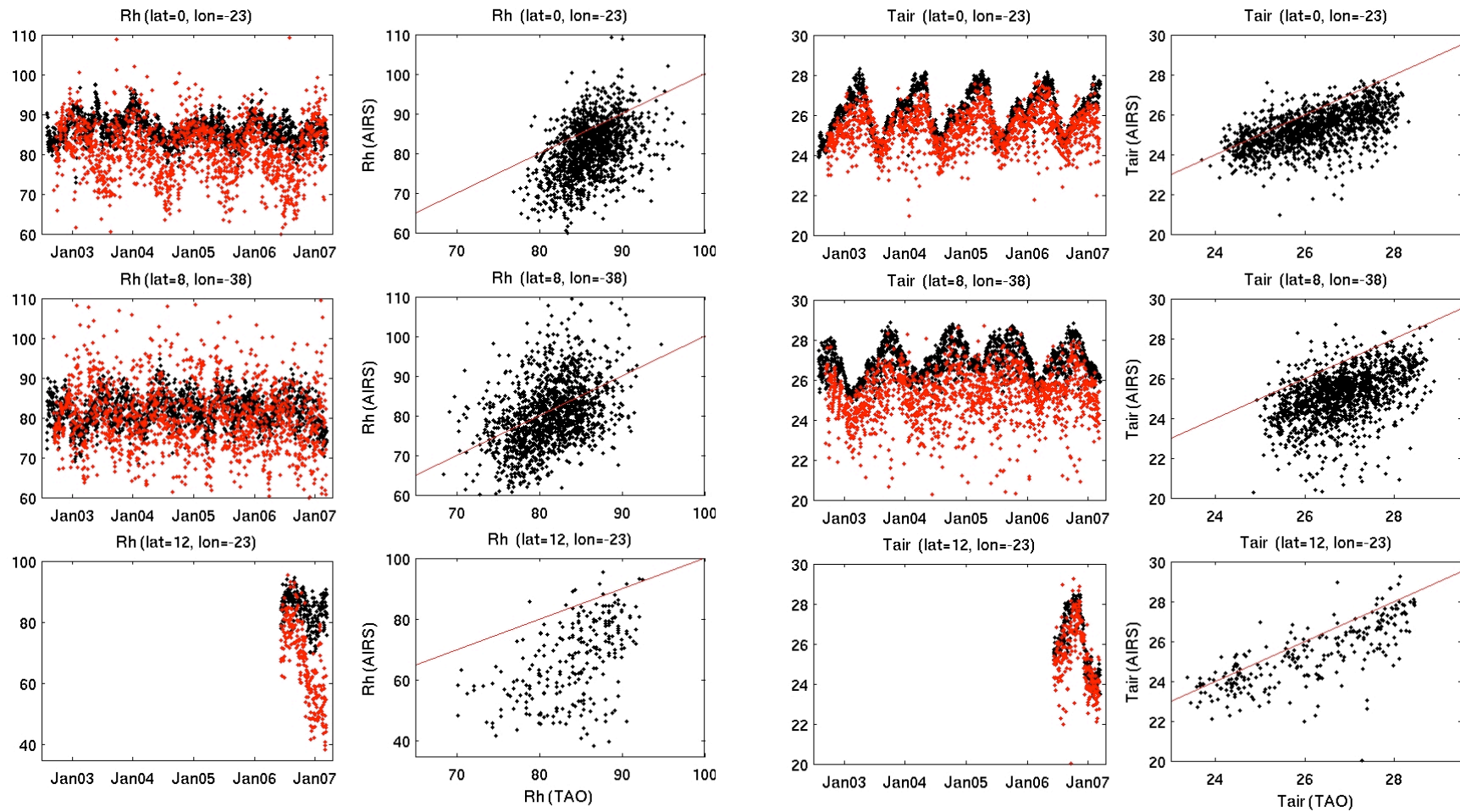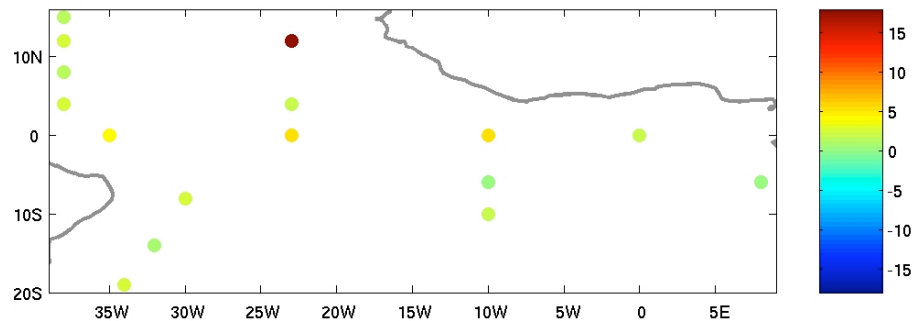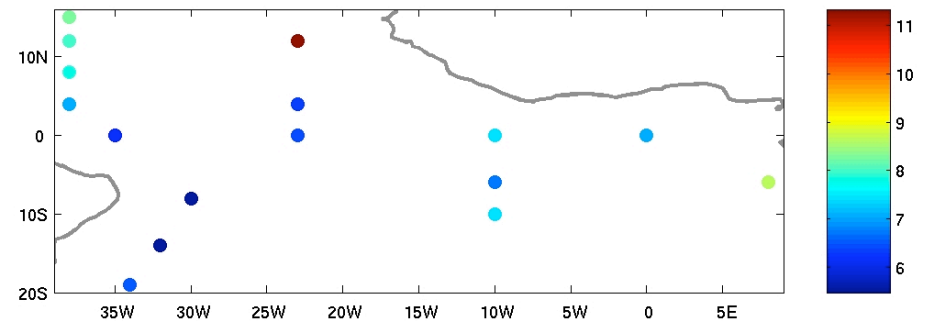Black ---TAO

AIRS to with PIRATA Buoy Data

Mean Biases of the surface Relh
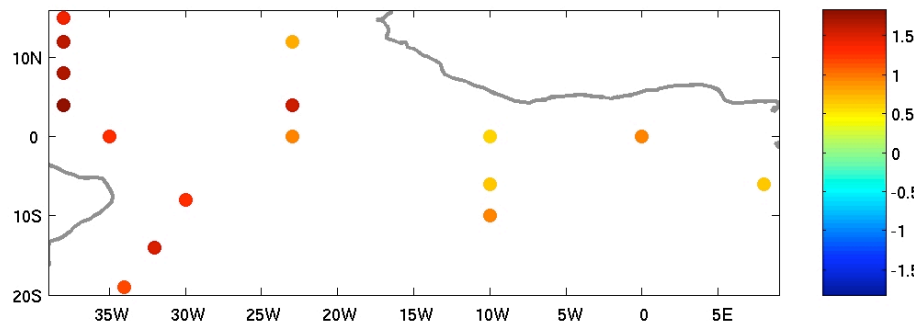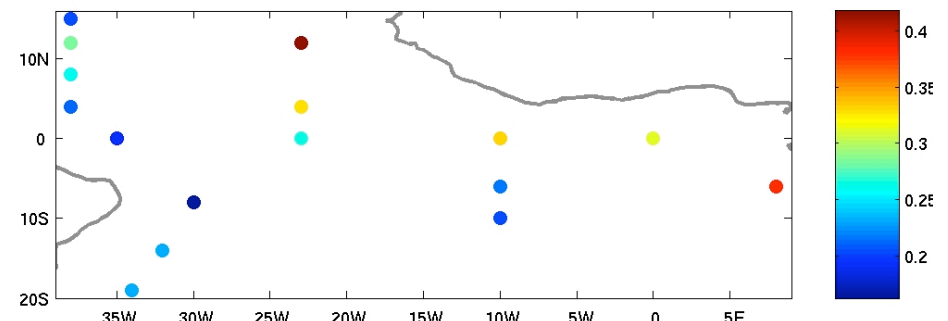
Standard deviation of the surface Relh differences

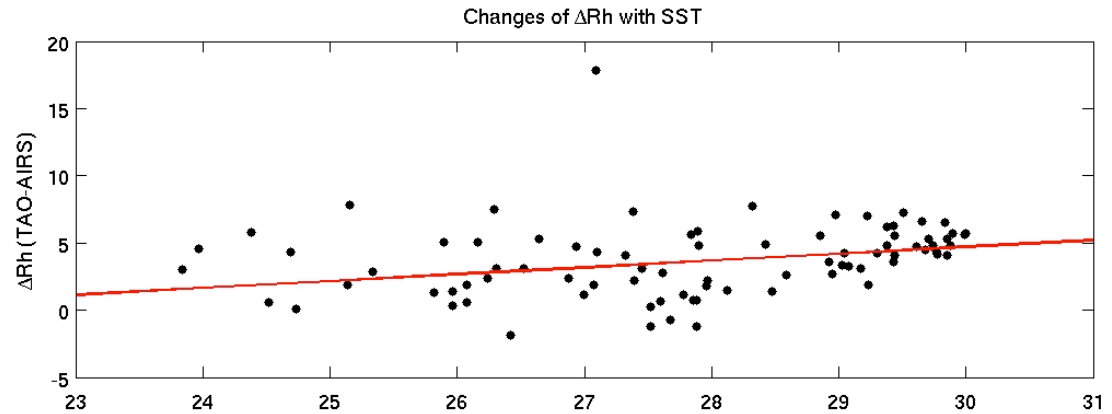Mean Biases of the surface Tair

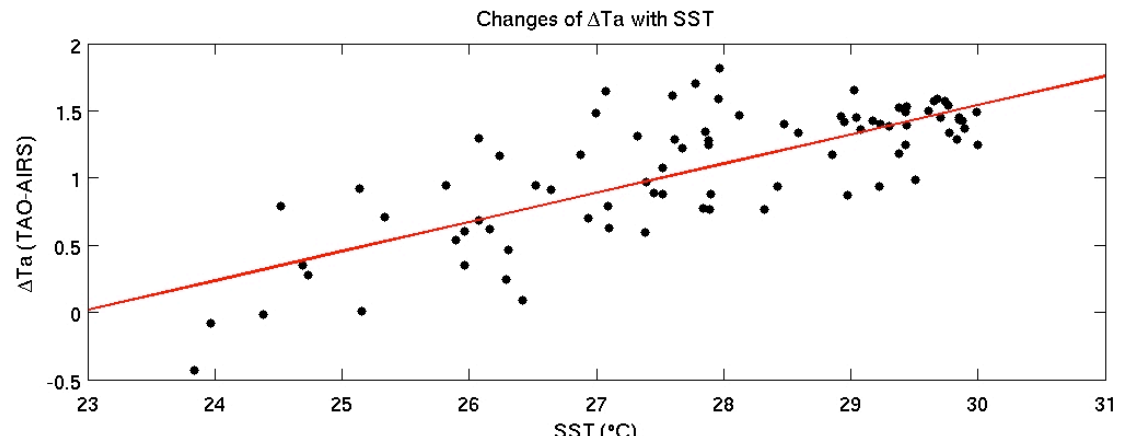Standard deviation of the surface Tair differences

Changes of mean biases of surface relative humidity and air temperature with SST (TAO+PIRATA)

Changes of the mean biases of surface relative humidity with SST

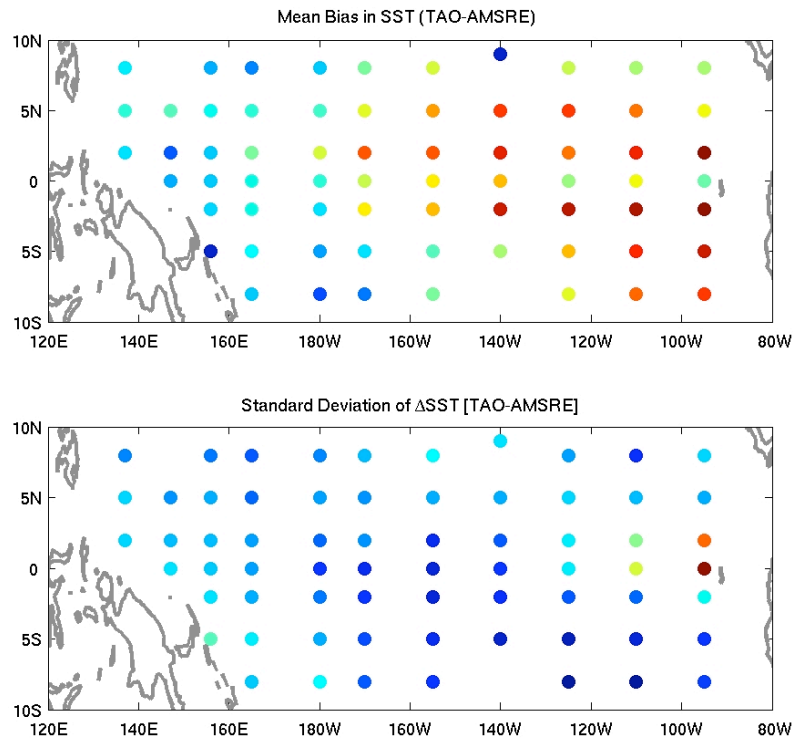Changes of the mean biases of surface air temperature with SST

Red line: robust linear fit

Conclusions

- Surface relative humidity shows substantial scatter: AIRS is biased low in the tropics and biased high in the Southern Ocean.

- Surface air temperatures also show relative scatter, and are biased cold in both the Southern Ocean and tropics.

- Biases in the relative humidity and air temperature increases with increasing SST (or surface air temperature).

➢ Additional radiosonde measurements collected from ships of opportunity will give a better assessment of AIRS performance in the marine boundary layer.

AMSRE to TAO

Mean Bias in SST (TAO-AMSRE)

Standard Deviation of ΔSST [TAO-AMSRE]

Mean Bias in SST (TAO-AMSRE)

Standard Deviation of ΔSST (TAO-AMSRE)

Mean Biases:
Top --- surface relative humidity
Bottom --- surface air temperature
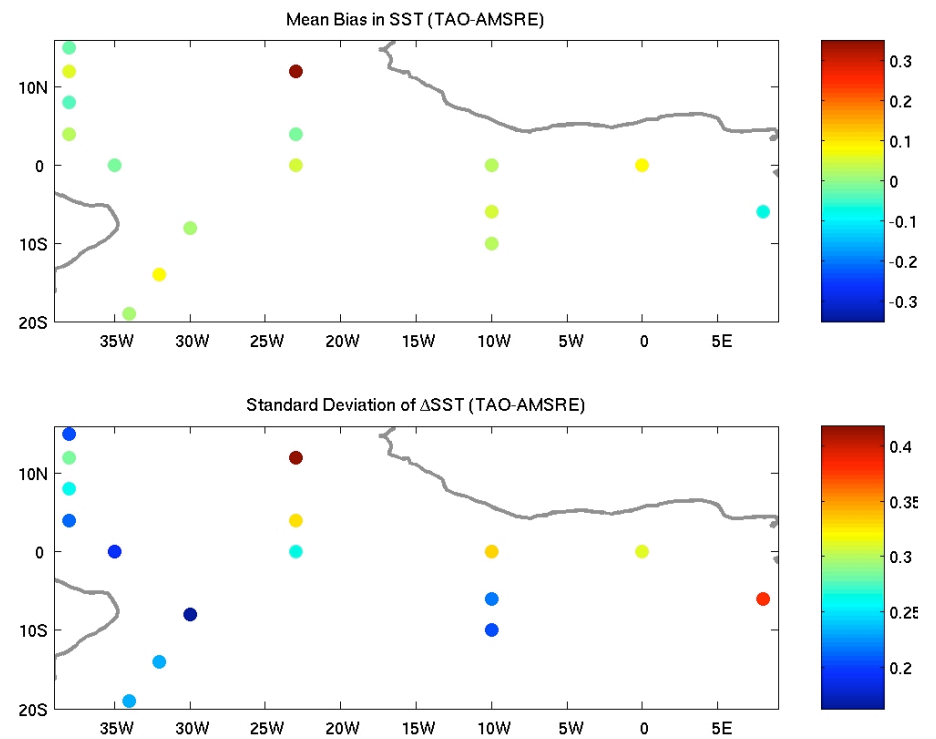
Standard Deviation:
Top --- surface relative humidity
Bottom --- surface air temperature